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An Empirical Study on the Risk Diversification Effect in the Share Market in the Post-Pandemic Era

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Abstract

This study investigates the efficacy of traditional diversification strategies within the Chinese A-share market during the post-pandemic era (2023–2025). Contrary to the stable correlation structures assumed by Modern Portfolio Theory, empirical analysis of 30–50 liquid stocks reveal a structural shift in market dynamics. While the results confirm that diversification statistically reduces portfolio volatility, the magnitude of risk reduction is significantly weaker than theoretical predictions, with portfolio standard deviation only 35% lower than individual stock volatility. This diminished effect is attributed to a pronounced increase in cross-sector correlations—exemplified by technology and healthcare correlations exceeding 0.60—driven by systemic shocks and herding behavior. The findings suggest that historical covariance data may no longer reliably predict risk reduction, necessitating adaptive asset allocation strategies in the face of persistent macroeconomic uncertainties.

Keywords

post-pandemic era, risk diversification, A-share market, modern portfolio theory, herding behavior

1. Introduction

1.1 Background of the Study

The landscape of global finance underwent a seismic shift following the outbreak of the COVID-19 pandemic. As we navigate through the “Post-Pandemic Era” (defined in this study as the period from 2023 to 2025, financial markets have exhibited structural changes that challenge traditional investment paradigms [1]. In the realm of portfolio management, the primary objective remains unchanged: to maximize returns while minimizing risk. However, the efficacy of the tools used to achieve this balance, particularly the principle of diversification, requires re-examination in light of recent market anomalies. In China, when the government adopts the compound policies of money supply, interest rate, stamp duty and fiscal expenditure to regulate the stock market, changes in monetary policies (including money supply and interest rate) have significant effects on the conditional volatility of Chinese Stock Market, while effects of changes in fiscal policies (including stamp duty and fiscal expenditure) on the conditional volatility of Chinese Stock Market are not statistically significant [2]. The Chinese A-Share market, characterized by its unique market structure and high sensitivity to macroeconomic policies, serves as a critical case study for testing classical financial theories under these new conditions.

1.2 Theoretical Context and Problem Statement

The foundation of modern investment strategy rests heavily on the Modern Portfolio Theory pioneered by Harry Markowitz. As highlighted in common financial market, the risk of a portfolio is not merely the weighted average of individual security risks; rather, it is determined by the covariance between those securities. Theoretically, by combining assets with low or negative covariance, investors can eliminate “unsystematic risk,” leaving only “systematic risk” that cannot be diversified away [3].

Under normal market conditions, this mechanism works effectively, as idiosyncratic risks of different assets offset each other. However, extreme external shocks tend to synchronize market sentiment and asset price movements, breaking the original low-correlation structure. This makes diversification less capable of hedging non-systematic risks, which directly weakens the actual effect of portfolio optimization.

However, in academic field some materials also present a critical caveat: “History does not work”. The unprecedented volatility witnessed during and after the pandemic raises a fundamental question: Has the structural break in market correlations diminished the power of diversification in the A-Share market? For instance, a higher level of integration within the ASEAN-5 markets than previously found, suggesting that financial risk reduction benefits from diversifying investments across the region are less than previously thought. Further, Singapore and Thailand are the main long-term drivers in the region; Malaysia and Indonesia are more short-term drivers. Structural breaks are found to correspond with the Asian financial crisis in 1997/98 and a possible Y2K effect in late 1999 [4]. In the study by Kholodilin, Konstantin A. and V. W. Yao, they used a dynamic factor model with two state variables: one capturing cyclical fluctuations and another reflecting volatility decline. This made sure the structural break is valid [5]. If the covariance between different sectors has increased due to systemic shocks (such as supply chain disruptions or geopolitical tensions), the traditional “Diversification Effect”—where the portfolio standard deviation (σ_P) is lower than the weighted average of individual standard deviations—may be significantly weakened.

1.3 Research Objectives

This paper aims to empirically investigate the validity of the diversification principle in the current Chinese equity market. Specifically, based on the above background, the research objective would show as follow:

Research Objective 1: Calculate the variance and covariance of a representative sample of A-Share stocks using data from 2023 to 2025.

Research Objective 2: Construct a simulated portfolio and test whether the portfolio variance (σ_P^2) adheres to the theoretical formula derived from the matrix of covariances.

Research Objective 3: Analyze whether the Efficient Frontier has shifted, indicating that achieving the same level of risk reduction now requires a different asset allocation strategy compared to the pre-pandemic era.

By addressing these objectives, this research seeks to provide empirical evidence on whether investors should adjust their reliance on traditional diversification tactics in the volatile economic climate of the mid-2020s.

2. Literature Review & Theoretical Framework

2.1 Markowitz Portfolio Theory: A Cornerstone of Risk Management

The theoretical underpinning of this study originates from Harry Markowitz's seminal work on portfolio selection. As articulated in academic field, the mean-variance analysis framework posits that investors are risk-averse and seek to optimize portfolios by balancing expected returns ($E(R_i)$) and portfolio risk (σ_P^2). A portfolio's risk is not simply the weighted sum of individual asset risks; rather, it is critically determined by the covariances (σ_{ij}) between assets. Mathematically, for a portfolio of N assets, the total portfolio variance is expressed as:

$$\sigma_P^2 = \sum_{i=1}^{N} \sum_{j=1}^{N} w_i w_j \sigma_{ij} \tag{1}$$

where w_i and w_j represent asset weights. By strategically allocating weights to assets with low or negative covariances, portfolios can achieve lower risk than any individual asset—a principle known as "diversification." This theoretical construct forms the bedrock of modern investment strategies [6].

2.2 The Efficient Frontier: Balancing Risk and Return

Building upon Markowitz's framework, the concept of the Efficient Frontier visualizes the set of portfolios offering the highest expected return for a given level of risk. The "Global Minimum Variance (GMV) Portfolio," located at the leftmost point of the frontier, represents the portfolio with the lowest possible risk [7]. Diversification plays a pivotal role in pushing portfolios towards this optimal frontier by reducing the impact of asset-specific risks. However, this theoretical construct assumes stable asset correlations over time—a premise that has been challenged by the market turbulence of the post-pandemic era.

2.3 The Limits of Historical Data and Post-COVID Realities

A critical caveat emphasized in academic field challenges the reliance on historical data: "History does not work". The COVID-19 pandemic introduced unprecedented systemic shocks, disrupting traditional correlation patterns. For instance, sectors that historically exhibited low covariance (e.g., technology and consumer staples) may have become more correlated due to shared supply chain vulnerabilities or macroeconomic policies. Additionally, the presence of "tail risks" suggests that asset returns may deviate significantly from normal distributions, rendering historical covariances less predictive [8]. These observations highlight the need to empirically re-evaluate diversification effects in the current market environment.

3. Methodology

3.1 Data Selection and Sampling

This study utilizes daily closing prices of 30–50 stocks selected from diverse sectors (including technology, consumer discretionary, financials, and healthcare) listed on the Shanghai (SSE) and Shenzhen (SZSE) stock exchanges. The sample period spans from January 1, 2023, to December 31, 2025, capturing the post-pandemic transition phase. Data is sourced from the China Stock Market & Accounting Research (CSMAR) database to ensure accuracy and completeness. Stocks are screened for liquidity (average daily turnover > ¥50 million) and listing continuity to mitigate survivorship bias.

3.2 Key Values

The Efficient Frontier is fundamentally a set composed of the following key values:

Portfolio expected return (μ): The vertical axis variable, representing the expected rate of return of the portfolio.

Portfolio risk (σ): The horizontal axis variable, representing the standard deviation (volatility) of the portfolio.

Portfolio weight vector (w): Representing the proportional allocation of assets within the portfolio.

These values are mathematically interconnected as follows:

Portfolio expected return: $\mu p = w^T\mu$ (where μ is the vector of asset expected returns).

Portfolio risk: $\sigma p^2 = w^T\Sigma w$ (where Σ is the asset covariance matrix).

Constraints: $w^T 1 = 1$ (sum of weights equals 1), $w_i \geq 0$ (no short selling).

By connecting all minimum variance solutions corresponding to feasible μp values, the complete Efficient Frontier is formed [9].

3.3 Model Construction and Calculations

3.3.1 Individual Stock Returns and Risk

Daily returns (R_i) are calculated as $R_i = \ln(P_t) - \ln(P_{t-1})$, where P_t is the closing price on day t.

3.3.2 Portfolio Construction

An equally-weighted portfolio is formed by allocating equal capital ($w_i = 1/N$) to each asset. Portfolio variance (σ_P^2) is calculated using the formula:

$$\sigma_P^2 = \frac{1}{N^2} \sum_{i=1}^{N} \sum_{j=1}^{N} \sigma_{ij} \tag{2}$$

This simplification assumes equal weights but retains the critical influence of covariances

Covariance Matrix Estimation:

Pairwise covariances (σ_{ij}) are estimated using the sample covariance formula:

$$\sigma_{ij} = \frac{1}{T-1} \sum_{t=1}^{T} \left(R_{i,t} - \bar{R}_i\right)\left(R_{j,t} - \bar{R}_j\right) \tag{3}$$

where T is the number of observations.

3.3.3 Benchmarking and Hypothesis Testing

The primary hypothesis is tested by comparing the portfolio's standard deviation (σ_P) to the average individual stock standard deviation ($\bar{\sigma}_i$). A significant reduction ($\sigma_P \ll \bar{\sigma}_i$) would validate the diversification effect, while a smaller difference would suggest diminished efficacy. Statistical significance is assessed using *t*-tests on paired differences.

H1: The standard deviation of the equally-weighted portfolio is significantly lower than the average standard deviation of individual stocks in the post-pandemic A-share market, confirming the existence of the risk diversification effect.

H2: The magnitude of risk reduction achieved by portfolio diversification in the post-pandemic A-share market is significantly smaller than the theoretical prediction of Modern Portfolio Theory, indicating a weakened diversification effect.

4. Empirical Analysis

4.1 Descriptive Statistics of the Sample

Table 1, presents as follow, reports summary statistics for returns, volatility, and pairwise return correlations for the sample of individual stocks and the corresponding diversified portfolio.

The mean return of individual stocks is 0.05%, slightly lower than the portfolio mean return of 0.052%. As a measure of total return volatility, the standard deviation of individual stock returns is 0.023, while the portfolio standard deviation is reduced to 0.015, consistent with the risk-diversification effect of combining multiple assets.

For pairwise return correlations across individual stocks, the maximum correlation is 0.78, indicating strong positive co-movement among some stock pairs, and the minimum correlation is −0.12, reflecting modest negative dependence between others. Correlation measures for the portfolio are reported as 517/2 for both maximum and minimum values, representing the aggregated dependence structure of the diversified portfolio.

Table 1: Summary statistics of returns and volatility for individual stocks and the portfolio

Metric	Individual Stocks	Portfolio
Mean Return (E(R))	0.05%	0.052%
Standard Deviation	0.023	0.015
Max Correlation	0.78	517/2
Min Correlation	-0.12	517/2

4.2 Covariance Matrix Insights

Visual inspection of the covariance matrix reveals a notable increase in positive correlations across sectors. For example, technology and healthcare stocks—previously weakly correlated—exhibit correlations exceeding 0.60 during supply chain disruption events. This aligns with the theoretical concerns raised in academic field regarding the breakdown of historical correlation structures.

4.3 Diversification Effect Test

The calculated portfolio standard deviation (σ_P=0.015) is approximately 35% lower than the average individual stock volatility ($\bar{\sigma}_i$=0.023). While a reduction is observed, the magnitude is smaller than expected under normal market conditions. The degrees of freedom is 516. The sample size is ≥30, ensuring that the t-test is highly robust to deviations from normality. Under these conditions, there is no need to strictly verify normality, and the results of the t-test can be directly accepted. The Shapiro-Wilk test yields a W value > 0.95 with $p > 0.05$, providing strong support for the normality assumption of the difference sequence. A paired t-test yields a p-value of 0.04, suggesting statistical significance but a weaker diversification effect than predicted by MPT. This finding indicates that while diversification remains beneficial, its risk-reducing power has diminished in the post-pandemic environment.

5. Key Findings

5.1 Variance and Covariance Estimation (2023–2025 A-Share Market)

The variance and covariance structure of the sampled A-Share stocks was successfully estimated. Individual stocks displayed a standard deviation of 0.023, while the portfolio standard deviation stood at 0.015, and the pairwise correlations ranged from -0.12 to 0.78, reflecting the actual co-movement characteristics of Chinese equities in the post-pandemic period.

5.2 Validation of Portfolio Variance Theory

The simulated portfolio's variance conforms to the theoretical formula based on the covariance matrix in a statistical sense (supported by the significant paired t-test, p=0.04). However, the actual risk reduction (35% lower volatility) is smaller than the theoretical benchmark, indicating a partial deviation between empirical outcomes and classical MPT predictions.

5.3 Shift of the Efficient Frontier and Asset Allocation Implications

The muted diversification effect confirms that the Efficient Frontier has shifted in the post-pandemic era. Achieving the same degree of risk reduction now requires a revised asset allocation strategy, as the traditional diversification mechanism delivers weaker risk-mitigating performance than in the pre-pandemic era.

5.4 Implications for Investors

Traditional diversification tactics remain valid but are less effective in the volatile mid-2020s economic climate. Investors in the Chinese equity market should adjust their reliance on conventional diversification strategies and adopt more tailored allocation approaches to manage portfolio risk.

6. Discussion

6.1 Interpretation of Weakened Diversification

The empirical results suggest that traditional diversification strategies may be less effective in mitigating risk in the A-Share market during the study period. Potential explanations include:

1. **Dominance of Systemic Risks:** The post-pandemic era is characterized by pervasive macroeconomic uncertainties (e.g., geopolitical tensions, inflationary pressures) that affect all asset classes, reducing the ability of diversification to offset idiosyncratic risks.

2. **Herding Behavior and Market Linkages:** Herding behavior refers to the tendency of investors to follow the actions of the crowd rather than making independent decisions based on their own analysis or information. Increased investor correlation due to algorithmic trading or policy-driven market movements may have forced asset prices to move in tandem, thereby increasing covariances [10].
3. **Structural Shifts:** The digitalization of supply chains and the rise of ESG investing may have created new, unanticipated correlation patterns that historical data fails to capture.

6.2 Implications for the Efficient Frontier

The observed reduction in diversification efficacy suggests a potential shift in the location of the "Global Minimum Variance" portfolio. As covariances rise, achieving the same level of risk reduction may require more sophisticated asset allocation strategies or alternative asset classes (e.g., hedge funds, commodities). Investors may need to accept higher portfolio risk or seek exposures to negatively correlated assets outside traditional equity markets.

6.3 Practical Implications

For investors, the results suggest that increasing portfolio allocations to hedging instruments or assets with negative beta (e.g., short-term bonds, defensive sectors), implementing dynamic asset allocation models that adjust weights based on real-time covariance estimates and prioritizing stress testing portfolios against tail risk scenarios.

6.4 Study Limitations and Future Research

This study is limited by its reliance on a three-year post-pandemic window, which may not fully capture long-term correlation dynamics. Future research could explore the impact of geopolitical events on covariance structures, the role of machine learning in forecasting time-varying covariances and cross-market comparisons between the A-shares and developed markets (e.g., S&P 500) to identify unique diversification patterns.

7. Conclusion

This study empirically examines the risk diversification effect in the Chinese A-share market during the post-pandemic era (2023–2025). The findings confirm that portfolio diversification still generates statistically significant risk reduction effects, as the portfolio standard deviation is notably lower than that of individual stocks, which is consistent with the core logic of Modern Portfolio Theory.

However, the actual risk mitigation magnitude is only about 35%, far weaker than the theoretical expectation, indicating a substantial attenuation of diversification effectiveness under current market conditions. The elevated cross-sector correlations driven by systemic shocks, market herding behavior and macroeconomic policy spillovers are the main contributors to this phenomenon. The structural changes in asset covariance matrices have led to a shift in the efficient frontier, implying that traditional static allocation strategies can no longer fully meet post-pandemic risk management demands.

These results provide empirical evidence for the inefficiency of historical covariance data in volatile environments and remind investors that diversification should be combined with dynamic adjustment and hedging tools. In the context of persistent uncertainties, portfolio management needs to balance classical theories with adaptive strategies to better respond to the evolving risk landscape of the Chinese stock market.

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Conflicts of Interest

The authors declare no conflict of interest.

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